

REMARKS

The Examiner rejected claims 1-20 of the present Application under 35 U.S.C. § 112, second paragraph, as being indefinite. Claims 1-20 were also rejected under 35 USC §102(b) as being anticipated by Teramoto et al, (US 3,740,617) (hereinafter "Teramoto").

Independent claim 1 has been amended to more clearly define the subject matter of the present invention. In view of the foregoing amendment and the following remarks, allowance of claims 1-20 is respectfully requested.

REJECTION UNDER 35 U.S.C. §112

The Office Action rejected claims 1-20 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter, which the Applicant regards as the invention. The Examiner's rejections under Section 112 fall into three categories.

First, with regard to unamended claim 1, the Examiner asserts that the phrase "a device" in the preamble renders the claim indefinite because the claim does not limit the invention. The preamble of amended claim 1 more clearly defines the term "device" by stating, "A light emitting semiconductor device with spatially distributed current injection." Thus, amended claim 1 clearly and definitely identifies the claimed invention as a light emitting semiconductor device.

Second, the Examiner asserts that it is not clear how the "lateral confinement of light" is produced and formed on the triangle mesa structure. Amended claim 1 requires "an optical cavity formed on the semiconductor structure and shaped as a triangle mesa structure." This optical cavity is explained in connection with Figure 6 of the Application, where it states that the "optical cavity comprising an upper mirror 61, a waveguide layer 62 for vertical light confinement, and a lower mirror 63." (See page 7 of the Application.) Thus, as shown in Figure 6, the light is reflected back and forth between the upper and lower mirrors 61, 63. The device of the present invention is, of course, pumped, or initiated, by the application of a "spatially distributed current" to the optical cavity using the upper and lower electrodes. (See, e.g., the Field of the Invention.)

The lateral confinement of light flows from total reflection of the light from the triangle mesa structure side wall, which takes place for light incident angle 30^0 and refractive index $n_r > 2$. The details of the physical mechanism of lateral confinement and general optical modes structure for triangular cavities are known to those of skill in the art and can be found in a reference entitled "Lasing Modes in Equilateral-Triangular Laser Cavities" by H. C. Chang et al., Phys. Rev. A, Vol.62, 13816, (2000), which is attached hereto. Accordingly, the lateral confinement of light, as claimed in the present Application, is clearly and definitely set forth in view of the specification and in view of the knowledge of one of skill in the art.

Third, the examiner states that it is not clear how a plurality of contact spots formed on the upper electrode produce a maxima of optical field intensity. With respect to this issue, the present Application explains:

As the contact spots formed on the multi-contact upper electrode 4 correspond to the maxima of optical field intensity on a lateral plane in the triangle optical cavity in the mesa structure 3, the number of contact spots, N_{spot} , is equal to the number of the optical field intensity maxima, N_{max} , for the chosen optical mode in the triangle optical cavity, as follows:

$$N_{spot} = N_{max} \quad \text{Eq. (1)}$$

(Page 7 of the Present Application.) There is a one-to-one relationship between the number of contact spots and the maxima of the optical field intensity. Therefore, the correspondence between the number of contact spots and the maxima of the optical field intensity is set forth in the specification and makes clear the meaning of the claim language in question.

In view of the foregoing, independent claim 1 and claims 2-20, which depend from claim 1, are definite and clear in view of the disclosure of the present Application.

REJECTION UNDER 35 U.S.C. § 102

Claims 1-20 are rejected under 35 U. S. C. 102(b) as being anticipated by Teramoto. The Examiner asserts that Teramoto discloses a semiconductor structure comprising: a lower electrode, a substrate formed on the lower electrode, a triangle mesa structure formed on the

substrate, an upper electrode formed on the mesa structure, and a plurality of contact spots. After analyzing the cited prior art, the Applicant submits that there are differences between Teramoto and the present invention in terms of both function and structure.

With respect to functional differences, Teramoto teaches a structure and method for improving the heat dissipation property of a semiconductor such as a microwave generating avalanche diode. (See, e.g., the Abstract of Teramoto.) In contrast, the present invention claims an apparatus for generating and outputting light. (See, e.g., the Field of the Invention and Description of the Related Art of the present Application). More specifically, the present invention provides a light output device that overcomes the uncontrolled generation of a large number of optical modes, using a laser diode with an optical cavity that can be operated in a single optical mode or controllable multiple modes. Teramoto entirely fails to disclose the generation of light or a semiconductor laser, but merely discloses a semiconductor.

With respect to structural differences, Teramoto discloses a substrate, three mesa semiconductor units, and a heat dissipator (col. 2, lines 1-25, and col. 4, lines 6-22), wherein the heat dissipator contacts the surface of each of the mesa units. Additionally, a mesa etching treatment and a depositing process are practiced in the cited method for forming the cited structure (column 1, lines 63-67, column 2, lines 64-66). On the other hand, the apparatus of the present invention includes a substrate, a semiconductor structure, an optical cavity shaped as a triangle mesa structure, a lower electrode, and an upper electrode. (See, e.g., page 6, lines 15-23, and page 8, lines 11-16). Amended claim 1, and each of the remaining claims which depend from claim 1, require "an optical cavity formed on the semiconductor structure and shaped as a triangle mesa structure." Teramoto simply does not disclose an optical cavity of any kind.

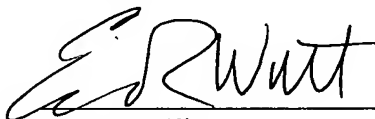
In addition, in conventional light-emitting devices, only one continuous metal film is used to form the contact. However, in the present invention, the Applicant uses a plurality of metal contacts to control the optical modes of the laser diodes. (See, e.g., claim 1, which requires "an upper electrode" with a "plurality of contact spots.") When the multi-contact spots are on top of a simple continuous metal film, as is the case with the prior art, this structure operates as a single

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contact spot, since all current will be distributed through the "multi-contact" to the whole metal film contact. In contrast, if a plurality of separate contacts are used, as is the case with the present invention, the current injection will only flow through the individual contact spots to the contact layer instead of being distributed to the whole mesa contact layer. Thus, the design of the present invention provides both superior control of optical modes and diminished energy consumption.

In summary, the prior art cited by the Examiner fails to disclose an optical cavity formed in a triangle mesa structure. The prior art also fails to disclose an "upper electrode on the top of the triangle mesa structure formed as a plurality of contact spots," as required by the claims of the present invention. Therefore, Applicant respectfully requests allowance of claims 1 to 20.

Respectfully submitted,



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